Solar Collectors You Can Build

Introduction

The prime factor slowing the widespread application of solar energy has been the cost of solar equipment, especially collectors. An alternative to buying a commercially-produced system is to build your own. For the simplest types of solar heating systems, the collector is the central and most costly component. This bulletin provides the needed information to build your own air collector or liquid collector. Solar collectors are based on the same natural laws that govern the "greenhouse effect". This greenhouse effect occurs when solar light energy passes through a transparent object (the cover plate) and is absorbed by a surface (the absorber plate) and converted to heat energy. Most of the heat energy is prevented from escaping the collector by the cover plate and is transferred to the fluid, either air or a liquid, inside the collector.

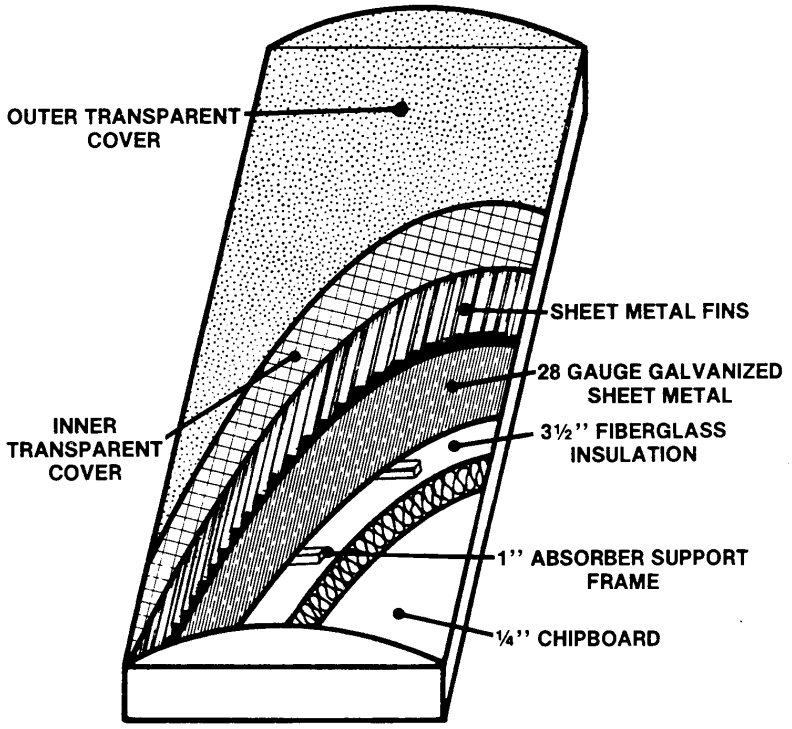

FIGURE 1 — CUTAWAY OF AIR COLLECTOR

Air Collector Construction

The following steps provide the construction sequence for an air collector shown in Figures 1 and 2.

1. Obtain all supplies listed under materials and tools.

2. Cut the two 8'-2" x 8 boards to 95" and cut two 50" lengths from the 10'-2" x 8" board.

3. Cut grooves in the 2 x 8's as shown on Figure 2. The ¼" wide groove accommodates the inner cover plate and the 1" wide groove houses the absorber backing frame. All grooves are ½" deep.

4. Cut a 1" x 3" board to 95 inches. This serves to support the back chipboard (Blandex) panel (Figure 2).

5. Rip a 12 foot 1 x 4 board into three ⅞" strips. From these strips, cut two 96 inch pieces and five 46½ inch pieces. Using these, the absorber backing frame is constructed.

6. Cut the arched extension boards from a 10 foot 1" x 4" board. The center of the arch is 2¾" with a gentle taper down to a point at each end of a 47" board. The center extension board is cut with a middle thickness of a 3½" tapering down to ¾" at each end of the 47" length.

7. Treat all wood pieces with a wood preservative or exterior stain. **Do not** treat the center extension board and one side of each of the outer extension pieces. Also **do not treat the space on the** 2 x 8's between the 1" and ¼" grooves.

8. Varnish all stained surfaces with an ultraviolet resistant exterior varnish. **Do not varnish the unstained areas in Item 7 above.**

9. Attach one of the 50"-2 x 8 ends to the 95" long sides with four washered 5/16" x 3" lag screws. Two screws are inserted at each end of the 50" board (Figure 3). Attach with 10d nails the 1" x 3" back support board to the center of the 2 x 8 forming the end of the collector.

10. Assemble the absorber support frame with 6d nails using the ⅞ inch wide board strips (Figure 4). The 96 inch pieces are used on the

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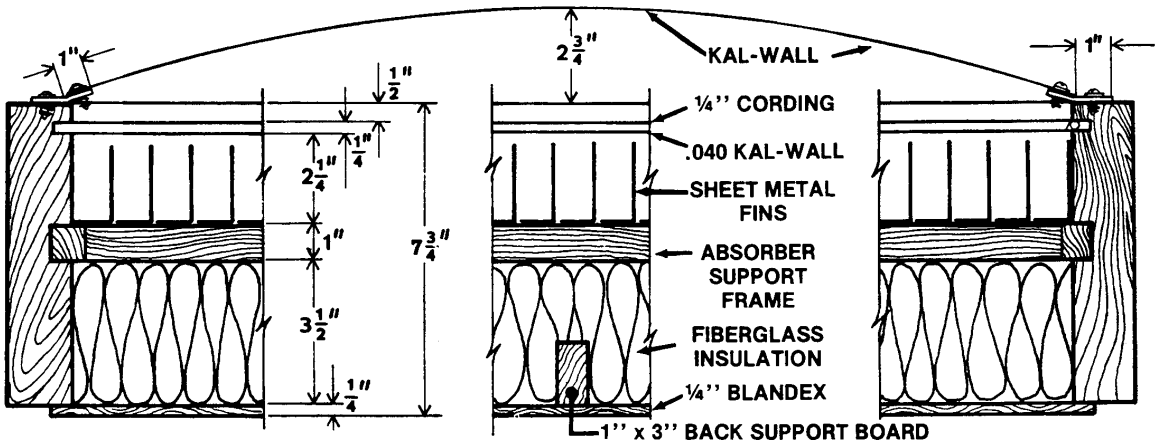

FIGURE 2 — CROSS-SECTON OF AIR COLLECTOR

sides with the 46½ inch pieces spanning across the collector at two foot intervals.

11. Cut holes in a 28 gauge 4' x 8' sheet metal to fit air inlet and exit ducts. The rectangular slots should be cut to match straight standard 2½" by 14" sheet metal boots (Figure 5).

12. Place the sheet metal on top of the support frame and slide them into the collector frame in the 1" groove.

13. Insert inlet and exit boots through the sheet metal from back and nail with 3d nails to support frame.

14. Seal the sheet metal to the collector frame with butyl-flex caulking around its perimeter.

15. Place the fiberglass insulation strips in place in back of the collector with the paper away from the absorber. Staple the paper to the wood frame and back support board. Trim insulation around air ducts.

16. Apply caulking to the back perimeter of the 2 x 8 frame and nail blandex panel in place with 3d nails.

17. L-shaped 1" x 2" - 28 gauge sheet metal fins for the absorber unit can be made at a local sheet metal shop. The 1 inch side is painted on the inside with a **high temperature** flat black spray paint. (Be sure the paint can withstand 400°F).

18. The 48 sheet metal fins are assembled on two 1" x 1" - 28 gauge galvanized angles to form the absorber unit. Mark off 47 - 1" spaces along the 1" x 1" angles. Use ½" - #6 sheet metal screws, inserted from the bottom, to attach the fins. The last two fins are attached by reversing one to lap over the other (Figure 2). This provides for sheet metal against the collector frame on each side.

19. Place the absorber unit in the collector box on top of the sheet metal already in place.

20. Slide a 4' x 8' Kalwall sheet into the ¼ inch groove in the collector frame.

21. Apply caulking to the end of the sheet metal, the absorber support frame, and the blandex panel on the open end. Put the remaining 2 x 8 end piece in place and attach with four washered 5/16" x 3" lag screws. Nail the blandex panel to the 2 x 8 with 3d nails.

22. Push the ¼ inch sash rope into the groove above the Kalwall sheet on all sides of the collector. Run a bead of caulking over the rope to seal the collector around the perimeter.

23. Spray the center extension board and the unstained side of the end extension boards with a silver colored paint.

24. Attach the end extension boards with the silver side flush with the inside of the end 2 x 8's. Fasten in place with the 1½" x 1½" corner brackets. These are bent to fit the 2 x 8.

25. Fasten the center extension board at the center point of each side 2 x 8 with the strap joiners.

26. The 96" long sheet metal anchor strips are attached to the edge of the second 4' x 8' Kalwall sheet with ½" sheet metal screws at 8 or 9 inch intervals to hold the Kalwall and anchor strips together (Figure 6). To seal the joint, a small bead of caulking is run along the edge before assembling.

27. Run a bead of caulking along the collector sides and over the extension boards to seal the outer Kalwall as it is placed on the collector. Align the Kalwall evenly and fasten in place with screws and rubber washers. The ¾" wide x 48" sheet metal (28 gauge) strips are used between the rubber washers and the Kalwall when fastening the cover plate to the extension board with 1" - #8 wood screws.

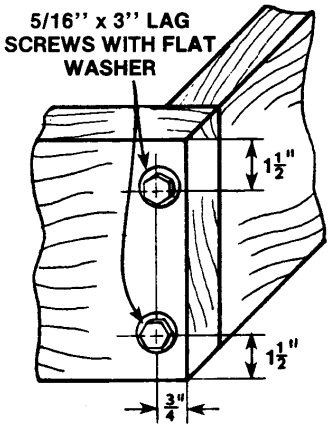

FIGURE 3 — LAG BOLT ATTACHMENT

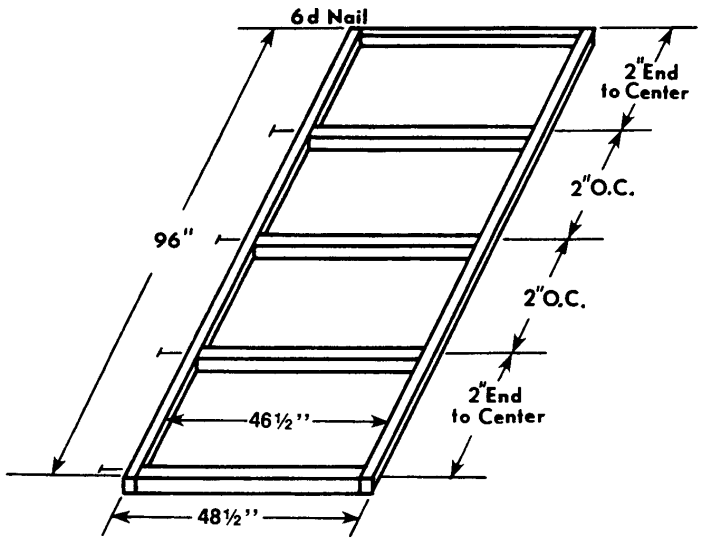

FIGURE 4 — ABSORBER SUPPORT FRAME

28. Drill a small hole through the end extension board which will be on the bottom to provide a small vent for moisture to escape.

29. The collector is now finished and ready for mounting and use.

List of Tools

Hammer • Screwdriver • Pliers • Electric Handsaw with Guide or Router • Utility Knife • Caulking Gun • Adjustable Wrench • Drill and Drill Bits • Tin Snips

List of Materials for One 4' x 8' Collector Panel

2 - 2 x 8 - 8' Kiln Dried Fir
1 - 2 x 8 - 10' Kiln Dried Fir
1 - 1 x 4 - 10' #2 Pine
1 - 1 x 4 - 12' #2 Pine
1 - 1 x 3 - 8' #2 Pine
1 - 4' x 8' - ¼" Chipboard
1 - 4' x 8' Sheet Metal - 28 gauge
16' - 6" x 22½" Fiberglass Insulation (Paper-backed)
2 - 4' x 8' - .040 Premium Kalwall (Sheet)
48 - 1 x 2 x 90" Sheet Metal Angle - 28 gauge
2 - 1 x 1 x 47" Sheet Metal Angle - 28 gauge
3 - ¾ x 48" Sheet Metal Strips - 28 gauge
2 - Sheet Metal Anchor Strips - 28 gauge (for outer cover sheet) (96" long) — as per detail drawing
8 - 5/16 x 3 Lag Screws
8 - 5/16 Flat Washers
4 - 1½ x 1½ 90° Corner Brackets (for end extension boards)
2 - 2" Flat Strap Joiners (for center extension boards
30 - Rubber Washers - ⅛" hole
30 - 1" Wood Screws #8
125 - ½" Sheet Metal Screws #6
2 - 11 oz. Tubes Butyl Caulking
25 - 6d Galvanized Nails
6 - 10d Galvanized Nails
40 - 3d Galvanized Nails

ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE NOTED

1 - Quart Exterior Wood Stain
1 - Quart Exterior Varnish (Sun-Resistant)
25 - ¼" Sash Cord
2 - Cans High Temperature Flat Black Spray Paint
4 - Sheet Metal Boots 6" round to 2¼" x 14"

Source of Materials (Partial Listing)

Kalwall Sources

J. Square & Sons
213½ N. 4th
Grand Forks, ND 58201
(701) 746-0348

W. L. Hall
14800 Morton Drive
Eden Prairie, MN 55344
(612) 937-8400

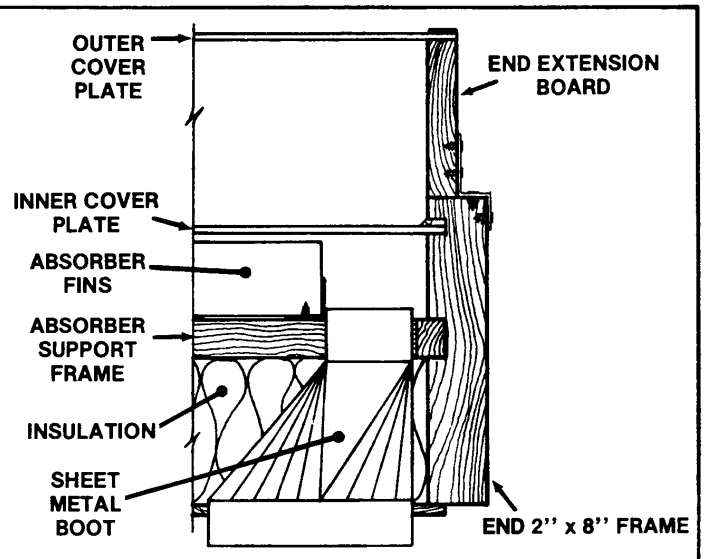

FIGURE 5 — SHEET METAL BOOT AND END ATTACHMENT

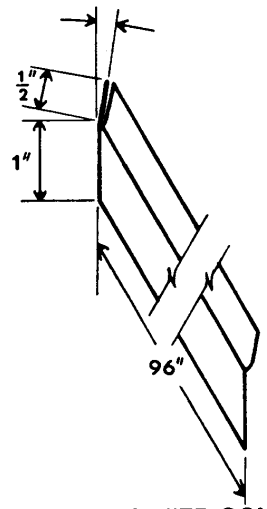

FIGURE 6 — OUTER COVER ATTACHMENT STRIP

Liquid Collector Construction

The following steps provide the construction sequence for the liquid collector Figures 7 and 8.

1. Obtain all materials and tools listed.

2. Cut the 8'-2 x 8 boards to 95" and cut two 50" lengths from the 10'-2" x 8" board.

3. Cut groove in 2 x 8's as shown on Figure 8. One ¼" wide groove accommodates the inner cover plate; the other ¼" groove holds the chipboard backing panel. The 1" groove holds the absorber support frame. All grooves are ½" deep.

4. Cut a 1 x 3 board to 95 inches. This supports the back chipboard panel.

5. Rip a 12'1 x 4 board into three ⅞" strips. Cut five 46½" pieces and cut from these strips two 96" pieces. From these, the absorber backing frame is constructed.

6. Cut the arched extension boards from a 10'-1 x 4 board. The center of the arch is 2¾" with a gentle taper down to a point at each end of a 47" length. The center extension board is cut with a middle thickness of 3½" tapering down to ¾" at each end of the 47" length.

7. Treat all wood pieces with a wood preservative or exterior stain. **Do not** treat the center extension board and one side of each of the outer extension pieces. Also, do not treat the space on the 2 x 8's between the cover plate groove and the absorber support frame groove.

8. Varnish all stained surfaces with an ultraviolet resistant exterior varnish. **Do not varnish the unstained areas in item 7 above.**

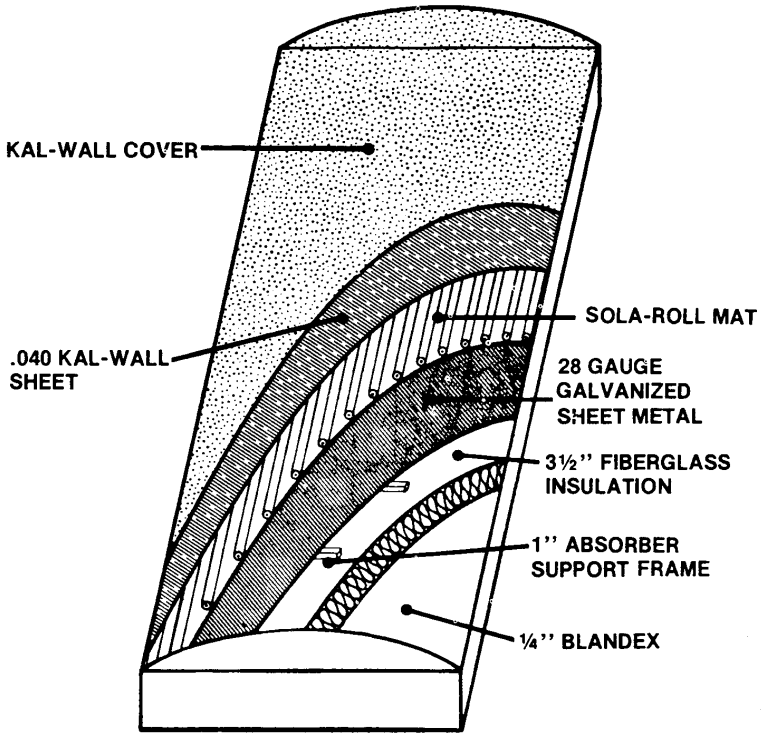

FIGURE 7: CUTAWAY OF LIQUID COLLECTOR

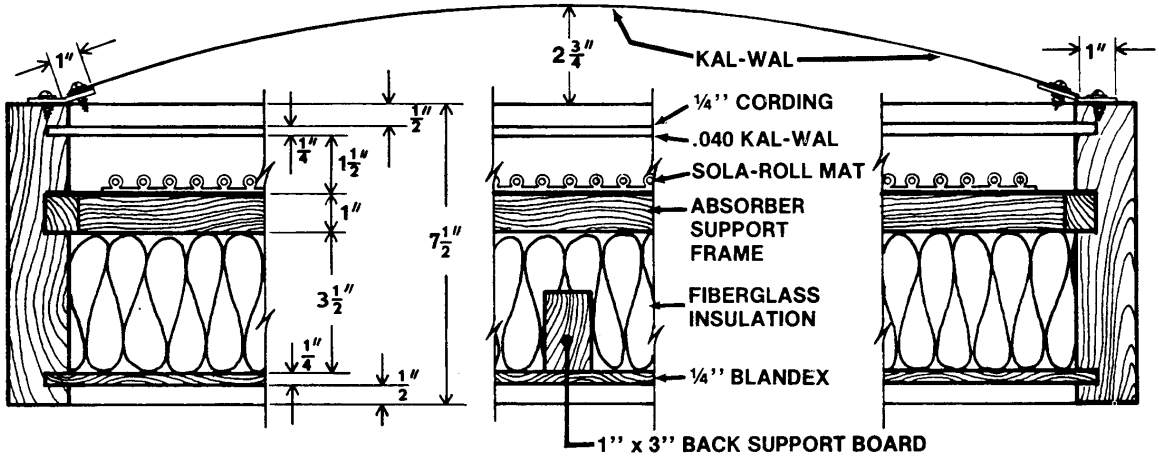

FIGURE 8: CROSS-SECTION OF LIQUID COLLECTOR

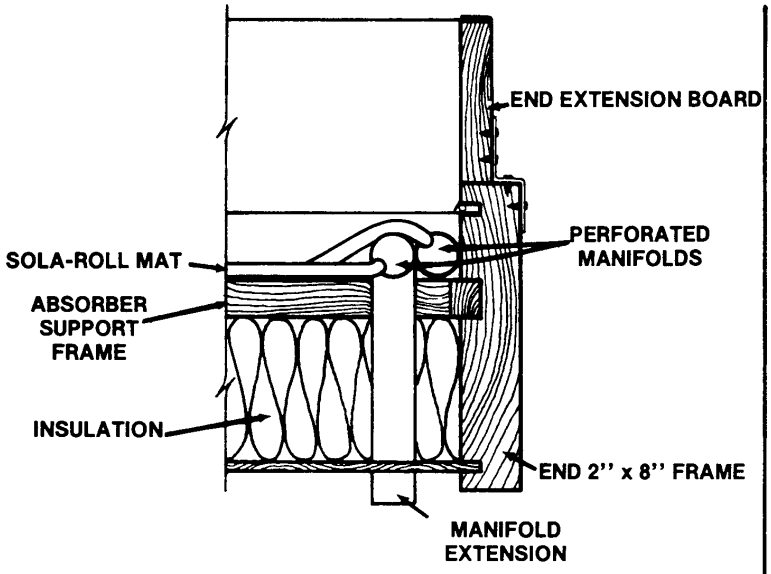

FIGURE 9 — MANIFOLD PLACEMENT

9. Attach one of the 50"-2 x 8 ends to the 95" long sides with four washered 5/16" x 3" lag screws (Figure 3). Two screws are inserted at each end of the 50" board. Nail with 10d nails the 1" x 3" back support board to the center of the 2 x 8 forming the end of the collector so that the back edge of the board is flush with the inside edge of the back panel groove.

10. Assemble the absorber support frame with 6d nails using the ⅞" wide board strips. The two 96 inch pieces are used on the sides with the five 46½" pieces as cross members spaced at 2 foot intervals.

11. Assemble the fittings to the headers as shown in the drawings to place the perforated holes as shown in Figure 9.

12. Cut holes in the 4' x 8' sheet metal for the supply and return headers. These holes should be located by lining up the manifolds as directed in Item 11 above.

13. Place the sheet metal on top of the absorber support frame and slide them together into the collector frame in the one inch groove.

14. Seal the sheet metal to the frame with a bead of caulking around its perimeter.

15. Place the fiberglass insulation in place behind the absorber support frame with the paper backing away from the absorber. Staple the paper to the wood frame and back support board.

16. Slide the blandex panel into the groove behind the insulation. Seal with a bead of caulking around the perimeter.

17. Cut the Sola-roll mat into five 17 foot lengths. Measure 8'-1" from each end and cut and remove the webbing between the tubes. Be careful not to cut the tube. You will have removed a 10" length of webbing.

18. Draw lines on the sheet metal 3 inches from each side and 6 inches from each end to identify the perimeter of the Sola-roll coverage.

19. Fold the Sola-roll strips in half making the 180° turns at the point where the webbing is stripped away. The tube forming the inner radius of the bend will be tucked under the next outermost tube and that pattern followed for each successive tube.

20. Spread the Sola-roll adhesive within the area laid out in Step 18. Follow directions on adhesive cartridge.

21. Press the Sola-roll strips in place on the adhesive, with webbing ends at the 180° turns on the line 6 inches from the top of the collector.

22. Cut holes in the back chipboard panel to match those in the sheet metal. Put the headers in place with their extensions through these holes.

23. Remove the webbing between the tubes to a point 2 inches above the top header (Figure 10).

24. Alternately cut the tubes to lengths of 2½ inches and 3¾ inches from the webbing end so that the tubes line up with the holes in the proper headers.

25. Slip the teflon inserts, provided with the Sola-roll mat, into the tubes to a depth of ½ inch. A drop of liquid soap may be helpful to ease insertion (Figure 11).

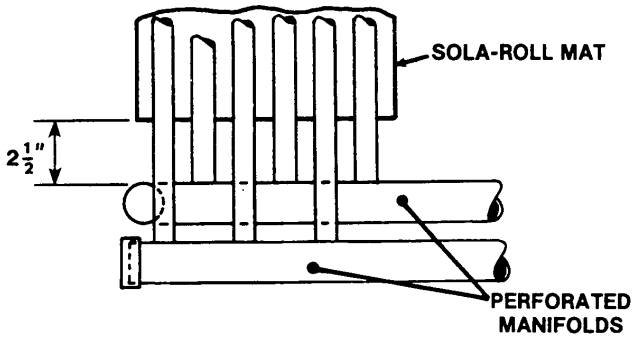

FIGURE 10 — TAKE DIMENSIONS AT HEADER END

26. Slide the manifold end of the insert into the header to a depth of about ½ inch.

27. By pushing on the rubber tubes where the end of the teflon insert is located, the insert is backed part of the way out of the tube, squeezing the rubber between the insert and the header. Repeat steps 25 through 27 for each tube.

28. Spray the center extension board and the unstained sides of the end extension boards with a silver colored spray paint.

29. Mark the center of a 4' x 8' Kalwall sheet and fasten it to the straight side of the center extension board. A ¾" sheet metal strip is used between the Kalwall and the rubber washer-screw combination. That is, the sheet metal strip goes on the side of the Kalwall towards the absorber. Use 4 screws.

30. Slide this sheet into the top groove with the extension board up.

31. Apply caulking to the end of the sheet metal, absorber support frame, and blandex panel. Put the remaining 2 x 8 end piece in place and attach with four washered 5/16" x 3" lag screws.

32. Push ¼" sash rope into the groove above the Kalwall and seal with a bead of caulking.

33. Attach the end extension boards with the silver side flush with the inside of the end 2 x 8's. Fasten in place with the 1½" x 1½" corner brackets bent to fit over the edge of the 2 x 8.

34. The 96" sheet metal anchor strips are attached to the edge of the second 4' x 8' Kalwall sheet to seal the joint. A small bead of caulking is run along the edge before assembling. Use ½" - #6 sheet metal screws at 8 or 9 inch intervals to hold together.

35. Run a bead of caulking along the collector's sides and over the extension boards to seal the outer Kalwall as it is placed on the collector. Align evenly and fasten with screws and rubber washers. The ¾" x 48" sheet metal strips are used between the rubber washers and the Kalwall when fastening the cover plate to the extension boards with 1" - #8 wood screws.

36. Drill a small hole through each end extension board to provide a vent for moisture to escape.

37. The collector is now finished and ready for mounting and use.

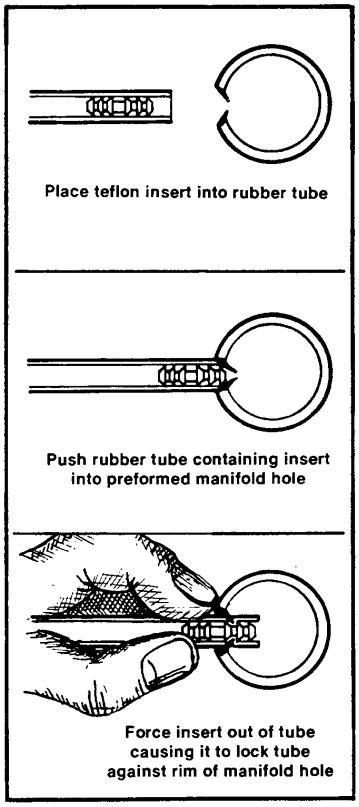

FIGURE 11—TUBE INSERTION

List of Materials for One 4' x 8' Collector Panel

2 - 2 x 8 - 8' Kiln Dried Fir
2 - 2 x 8 - 10' Kiln Dried Fir
1 - 1 x 4 - 10' #2 Pine
1 - 1 x 4 - 12' #2 Pine
1 - 1 x 3 - 10' #2 Pine
1 - 4' x 8' - ¼" Chipboard
1 - 4' x 8' Sheet Metal - 28 gauge
16' - 6 x 22½ Fiberglass Insulation
2 - 4' x 8' - .040 Premium Kalwall
85' - Sola Roll Mat
1 - Package Teflon Inserts (40 Pieces)
2 - Headers (for Sola-roll mat)
1 - Tube Sola-roll Adhesive (29 oz)
(Above three items available from Sola-Roll Distributors)

4 - ¾ x 48 Sheet Metal Strips - 28 gauge
2 - Sheet Metal Anchor Strips - 28 gauge (for outer cover sheet) — As per detail drawing
8 - 5/16 x 3 Lag Screws
8 - 5/16 Flat Washers
4 - 1½ x 1½ 90° Corner Brackets (for end extension)
34 - Rubber Washers ⅛" hole
34 - 1" Wood Screws #8
25 - ½" Sheet Metal Screws #6
2 - 11 oz. Tubes Butyl Caulking
6 - 10d Galvanized Nails
25 - 3d Galvanized Nails
25 - 6d Galvanized Nails

ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE NOTED

1 - Quart Exterior Wood Stain
1 - Quart Exterior Varish (Sun Resistant)
25 - ¼" Sash Cord

List of Tools

Hammer • Screwdriver • Pliers • Electric Handsaw with Guide or Router • Utility Knife • Caulking Gun • Adjustable Wrench • Drill and Drill Bits • Tin Snips

Reproduced in the interest of increasing energy efficiency and renewable energy awareness

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